

Uptake and accumulation of methylmercury by marine phytoplankton

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Introduction: Eating marine fish are the main source of the toxic and bioaccumulative methylmercury (MeHg) exposure in human. However, information about the accumulation process of MeHg through marine food webs is severely limited. Phytoplankton serve as a main entry for dissolved methylmercury (MeHg) into aquatic food webs. Thus, measuring uptake ratio and accumulation of MeHg by marine phytoplankton is critical for understanding mercury risks for marine organisms and human. To date, most research on the algal uptake of MeHg were conducted using freshwater phytoplankton, and there is few studies on marine species. In this study, we examined the uptake and accumulation of MeHg using 5 marine phytoplankton cultures affiliated with different algal lineages (2 diatoms, cyanobacteria, pelagophyte, and haptophyte), and evaluated that the differences of bioaccumulation between dead and live cells.

Materials and methods: Five axenic phytoplankton cultures *Thalassiosira pseudonana* (CCMP1335), *Thalassiosira oceanica* (CCMP1005), *Synechococcus* sp. (CCMP1334) *Pelagomonas calceolate* (CCMP1756), *Emiliania huxleyi* (CCMP374) were used for incubation experiments with MeHg addition. After preculture in L1 medium, all species were cultured axenically in the L1 medium with MeHg (ca. 1,000 pg / l) at 22°C under light or light:dark (12 h: 12 h) conditions. Incubation time was varied from several hours (short term) to days (long term). During incubation experiments, we collected subsamples of cultures several times. Phytoplankton cells (particulate fraction) were collected using the GF-75 glass-fiber filter, and stored at -80 °C until further analysis. Filtrate (dissolved fraction) was amended with H₂SO₄ and stored at 4 °C. To evaluate the bioaccumulation of dead and live cells, we used the *T. pseudonana* cells killed by heating (100 °C for 20 min). Particulate and dissolved MeHg concentration were analyzed using a combined technique of dithizone extraction and the EPA method 1630.

Results and discussion: Incubation experiments revealed that all phytoplankton cultures incorporated and accumulated MeHg during incubation. In addition, incorporated MeHg would not be released from phytoplankton cells during incubation experiment. Short term incubation experiments revealed that phytoplankton cells took up 60 to 87% of the amended MeHg within 1 hour. Cellular MeHg concentration varied among phytoplankton cultures, and those of *Synechococcus* sp. (0.1-0.2 ag MeHg / cell) were relatively lower than those of other cultures. Experiments using dead and live cells showed that MeHg concentrations of dead cells were obviously lower than those of live cells, suggesting that a active MeHg uptake for this culture. Our results suggest that phytoplankton cells could actively take up and accumulate MeHg, and bioaccumulation ratio varied among phytoplankton species.

Keywords: Marine, Methylmercury, phytoplankton